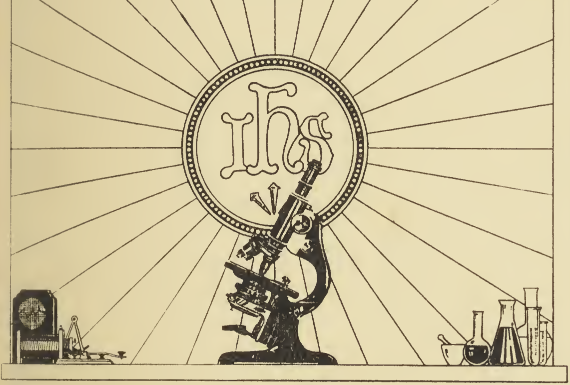
THE JESUIT SCIENCE BULLETIN



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NOTICE TO AUTHORS

Manuscripts are to be submitted to associate editors of the appropriate section and *may* be submitted directly to the editor in chief. Clear manuscript, preferably typed, with wide margin to the left, with double spacing between lines, is desirable. Please try to follow the typographical style of the most recent issue of the BULLETIN. Line drawings should be submitted on Bristol board. or similar material, and done in India ink. Figure number should be written on this in pencil. Titles for drawings, with figure numbers, should be typed on a separate sheet. Please try to minimize footnotes. Appended references and bibliographies, clearly so marked, should be done in the style of the A.A.A.S. publication, *Science.*

RADIOLOGICAL CIVIL DEFENSE

Rev. Thomas J. Smith, S.J.*

The development of Civil Defense as an integral part of national defense and its extension to coverage of natural disasters as well as enemy attack has necessitated several important changes in policy and operation. The advent of the megaton bomb brought about the decision to evacuate the population from possible target areas upon reception of the first warning of impending attack and forced changes to be made in the organization and technique of radiological defense to cope with the hazards of wide-spread radioactive fall-out. While the basic concepts and purposes have remained unchanged, the trend has been away from the enlistment and training of large numbers of people toward the formation of small groups of specialists in each phase of Civil Defense. In this way, interest is more surely sustained over a period of years and expert planning and direction of advanced methods of operation is assured. Since it is in connection with the radiological phase that colleges and universities can be of the greatest assistance to local and state Civil Defense organizations in providing the technical instruction and training, an outline of the part played by Holy Cross College in this department of Civil Defense for the last six years may be helpful and suggestive.

Toward the end of the year 1950 a survey of the results of the atomic bombs released over Japan had been completed and the first authentic information had been released by the Government in the book *Effects of Atomic Weapons*. Representatives from the colleges in the State were invited to a series of lectures presented by Dr. Bunker, at that time Dean of the Graduate School at M.I.T., as a preliminary to the establishment of a department of Civil Defense. In the course of the talks, a film, entitled *Tale of Two Cities*, and prepared by the U. S. Army was shown. One very impressive sequence in the documentary motion picture was an interview with Fr. John B. Siemes, S.J.,** of the Lower German Province, on the

*Author, Professor and Chairman of the Department of Physics at the College of the Holy Cross, has served the Commonwealth of Massachusetts since 1950 as *Radiac Officer* for District no. 3. This contribution delineates service which is at once technical and sacerdotal. His calm leadership as a priest in the remotely proximate may betoken the rôle of all of *ours* in a menacing event. This could well be a typical sample of numerous similar reports that many of ours in this *assistancy* could make. *Editor.*

**Fr. Siemes' account, *Atom Bomb on Hiroshima*, has been published in This Bulletin, *30*, 100 (1953).

reaction of the Fathers at Hiroshima and their Japanese neighbors to the bombing of their city. In January of 1951 we were requested by the Department of Public Health to take charge of the Radiological Defense Section of Civil Defense for the area of central Massachusetts. Two intensive courses were then offered, one in February and the other in May 1951. The former was conducted at M.I.T. and the other at the Cancer Clinic of the Deaconess Hospital in Boston. Among the instructors were the Radiological Officer at M.I.T., Nuclear Physicists at the Deaconess Hospital, Dr. Shields Warren, Director of the Cancer Research Institute of the Deaconess Hospital and advisor to the Atomic Energy Commission. Several of these men had been present at the Bikini Tests. These courses provided the necessary orientation and detailed instruction on instrumentation and protective measures for the Area Radiac Officers who were in turn to undertake the instruction and training of their area staffs, area survey teams and Local Radiac Officers.

Towards the end of the year 1951, the first of the Instructor-Level Radiological Courses for the area was given with an enrollment of twenty-two students. Since that time, five, twenty-five hour courses have been given at Holy Cross with a total enrollment of close to one hundred and fifty students. The people attending these instructor-level courses have been, for the most part, engineers, physicists and chemists, High School teachers of science and technical personnel from industry, public utilities, and state and municipal public works. The level of instruction was that of courses that could be given to top grade students of a freshmen college class. The subject matter of the course included the following: Nuclear radiations, interaction of radiation and matter, nuclear explosions, radioactive decay, measurement of radioactivity, fall-out, shelter and and shielding, decontamination, radiological survey, biological effects of nuclear radiation, permissible doses, and iso-intensity plotting. A large number of the graduates of these courses became members of local radiological staffs and instructors in lower level monitoring courses given to members of police and fire departments, public works and public utilities groups, and radiological protection teams connected with private industry.

During the initial stages of the inauguration of the general Civil Defense program we were invited to present the radiological defense problems involved at regional meetings throughout the central and western part of the State. Later on, when it came time to organize

on the local level, requests came in from the authorities to demonstrate the radiological instruments at meetings in Worcester and in the smaller cities and towns of the area. The State Department of Education, Vocational Division, scheduled a series of talks to groups of their instructors. Many of those attending later enrolled for the courses in Radiological Defense given at Holy Cross. There is a growing recognition of the need of competent individuals at the local level to advise the population as to the seriousness of the radiological hazard in time of attack and to direct shelter and decontamination measures. Ionization chambers, Geiger-Counters, dosimeters and associated equipment is now being issued to local communities where qualified instructors will undertake instruction in monitoring. A sufficient number of these instructors will have been trained at Holy Cross in the near future.

With the explosion of the nuclear bomb of megaton yield will almost certainly come a heavy fallout of radioactive dust that could extend over a downwind, elliptically-shaped area some two hundred miles long and 40 miles wide. A person fully exposed in this area will acquire a lethal dose of radiation in a very short time. Before any Civil Defense or other salvage operation can be started, it will be necessary to have plotted a state-wide set of iso-intensity lines in order that the personnel involved in these activities and the general population may be protected from dangerous doses of radiation. The basic radiological data will be collected both by local monitors and mobile survey teams operating out from each of the five sectors into which the four areas of the State is divided. The instruction and training of the area and sector staffs, the mobile teams and the local instructors is taken care of by Holy Cross. Radiological Defense operations in time of actual disaster will be under the direction of the area Radiac Officer also from Holy Cross. The Radiac Officer is also a member of the State Advisory Committee on Radiological Defense.

Participation even in this restricted phase of Civil Defense has resulted in very favorable public relations for the College, has emphasized gradually the fact that Holy Cross offers a good science curriculum as well as traditional Philosophy, Religion and Classics. It has also helped, we think, to break down a not inconsiderable reserve toward the Church on the part of many especially in the rural areas. The appearance of a priest on the stage of a local Town Hall talking on a technical subject creates some surprise at first but the audiences eventually become friendly and appreciative. From the be-

ginning, several members of the Boston College faculty have taken the lead in this same work in the Boston area and one of their number is at present a member of the State Staff.

INTRODUCTION TO STRUCTURAL INORGANIC CHEMISTRY. A SYLLABUS

Rev. Bernard A. Fiekers, S.J.*

Until recent years a full century's development of organic chemistry along classical lines has provided the ideal for the inorganic chemist. For, inorganic chemistry was developing as a descriptive science, cataloging numerous isolated phenomena, the very bulk of which threatened to break down its discipline. True, inorganic chemistry enjoyed generalizations of its own, lent to, or borrowed from, physical chemistry as the latter came of age. But such generalizations cast an unsatisfactory species of unity on the inorganic science, and it remained for the interplay of quantum mechanics with this mass of accumulated information to rationalize the periodic table of the elements and thus give renaissance to such ideals of unification which every science seeks. With this was structural chemistry born; the organic chemistry of carbon became but a particular case for its generalizations.

Recognizing today that the rigid mathematical approach to structural chemistry through quantum mechanics is often a barren study for students who are impatient to view the fruits from such deeply hidden roots, contemporary teachers humanely reverse their approach. Structural chemistry is introduced to the student as rapidly as possible. It is based on only the smallest number of quantum mechanical principles necessary for the task. Description accedes to systematization; interest is sustained; and research is fostered. The system is one of general correlation, rather than of the cause and

*Most Jesuit chemistry teachers soon find out that they have to come to equilibrium with the bread-winning courses of freshman, analytic or organic chemistry, at least at this stage of *our* scientific progress. Some work in upper division or graduate courses can be stimulating. Your editor's contribution to this issue is, he thinks, a modest culmination of almost fifteen years with these twinned subjects: general chemistry and structural chemistry. He offers this syllabus, so that others who have to teach structural chemistry can get the running start which his own wartime novitiate in the field did not provide. *Editor.*

the effect, of the why and the how. The interest may lead eventually to a more thorough exploration of the mathematical foundations. The guidance in research is recognized as fruitful.

For such reasons a thirty-lecture introduction to structural chemistry has been assembled by the author. It had been hitherto unavailable. Essentially an inorganic course, it includes the organic topics that pedagogical convenience might require. This syllabus follows.

Prerequisites are the usual undergraduate general inorganic, analytic, organic and physical chemistry courses, as well as their own prerequisites in turn. The ability to search the literature of chemistry is desirable or to be acquired. Accordingly, this course can be offered in the upper collegiate division or at the early stage of graduate work.

Review of appropriate matter is generally necessary. Typical review topics include: classical numerical valence; electronic or modern valence as a self-consistent model for the simpler elements (H, He, the first and most of the second shorter periods of the elements and the inert gases and their neighbors); and the periodic table of the elements in its commoner forms. Memorization of the long form of the latter is highly desirable.

An introduction to atomic orbitals is then undertaken. K L M N notation becomes 1 2 3 4; the sub-energy levels s p d f are introduced. The Fajans (1) rules for covalence, and that of Sidgwick (1) for ionic compounds are studied. Since the strength of acids is a direct function of proton ionization in solution, and that of bases reflects corresponding covalence, a practical application of these rules is at once provided.

A study of resonance (2) which might pervade any such treatise, is undertaken at an early stage in order to reconcile many of the structural anomalies which involve valence. In this connection the work of Pauling (3) and his many successors is of necessity to be reviewed. Occasion is here taken for outlining Pauling's *arguments* for resonance, such as accounting for *discrepancies* in heats of formation, anomalous dipole moment data and the like. His chart of the electronegativities of the elements is introduced. Some of his examples of resonance are studied. His treatment of hydrogen bonding is found convenient to follow.

The topic of variable valence is treated essentially as given elsewhere (4). This provides practice in atomic orbital notation as well as its *per se* value. The topic's practical corollaries include: a summary of common *redox* reagents; electrochemical methods of synthesis

and analysis; Latimer's *redox* potentials (5); and a study of *unfamiliar* oxidation states of the elements (6).

Co-ordination compounds and complex ions (7) are then studied. Inorganic isomerism (8) is best illustrated in this field; it has propagandic value for organic enthusiasts. A resume of isomerism in organic chemistry provides the good *ignotum a cognoto* introduction.

The correlation between atomic orbitals and molecular structure (9) follows. This is supplemented with a study of the isoelectronic (isosteric) (10) principle in order to correlate the structures of compounds (identical AO) otherwise so diverse. The first structural diagnostic is here available. Its potential for research is only now being explored.

By now the student is prepared for the topic of chelation (11) to a depth but seldom, generally achieved. At present this topic all but dominates chemical research.

A cursory discussion of structural diagnostics, such as magnetochemistry (12, 13), dipole moments, infra-red and the like is undertaken and at times scheduled in part in the seminar course.

This course is concluded with an introduction to molecular orbitals (14).

As in any course latitude is allowed in this syllabus from year to year. Concurrent laboratory work might demand a treatment of the phase rule as applied to certain crystallizations, or an introduction to non-aqueous solvents (15) for the synthesis of complex compounds or for modern methods of analysis. Current theses might call for expanding the chelation topic, the structural diagnostics, or even modern theories of acids and bases. Lectures on the interrelationships of the complex cyanides, the nitroso and carbonyl compounds might be used to augment the applications of the isoelectronic principle. Given time, there is room in this framework for the structural elucidation of numerous topics out of the whole wide field of chemistry.

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EFFECT OF ULTRASONIC VIBRATIONS ON VISIBILITY

Rev. Joseph L. Murray, S.J.*

The idea of vibrating an object under a microscope to bring it more sharply into focus has not passed beyond the theoretical stage with the present writer. It is submitted merely as a matter for discussion and possibly later for experimentation.

The project grew out of a very simple experiment which is a matter of everyday experience. If a dot of some sort is placed upon a piece of paper, or upon a blackboard and some kind of screen is placed over it, the overall perception of the dot is diminished. However, if keeping the dot covered with the screen, the screen is now moved more or less rapidly, the outline of the dot seen through the screen becomes clearer by reason of the motion. The same effect can be obtained by keeping the screen fixed and vibrating the dot itself rapidly. If a wide-meshed cloth such as cheese-cloth is placed flat against a printed surface and then moved laterally at fair speed the print beneath can be read more clearly because of the motion. Even partially translucent parchment placed flat against another surface seems to become transparent to an extent if it is moved.

*Author teaches physics and mathematics at Cranwell Preparatory School in Lenox, Mass. Thought provoking as they are, heuristic and discursive articles make welcome contributions. Author's plea for clarifications and suggestions in the closing line of this article deserves and challenges response. This paper was presented in the Physics Section of the Georgetown University Meeting in September, 1956 and was presented for publication in lieu of abstract. *Editor.*

Can this idea of motion for greater visibility be transferred from these simple experiments to the field under a microscope? Can a microslide be seen more clearly if, under certain circumstances and at certain frequencies it is set in motion? The moving screen in this last case will be supplied, perhaps, by the molecular structure of the object itself which is viewed. In their construction many crystalline solids follow a fixed pattern or lattice. Would the upper layer of molecules of an object once set vibrating externally by some mechanical means aid in peering more deeply into the object itself? Would it be possible by vibrating the upper molecules, say of sodium chloride to allow light to penetrate more deeply into the solid and illuminate molecules below the ordinary surface of visibility?

Analyzing briefly the simple experiments with which this paper began, points of similarity and of difference are apparent between these very elementary procedures and experiments under a microscope. The dot in question can be seen more clearly under a screen which is in motion because of the following reasons:

First, assume the screen at rest. When the screen is motionless certain parts of the object beneath it are hidden; only light passing through the openings in the screen will strike the object and be reflected back to the eye. Now the screen is moved,—other parts of the dot are illuminated and reflect light to the eye. More of the object is seen. The parts of the dot originally illuminated are not lost to view entirely because of the persistence of vision of the eye. Thus the latent image of all parts of the object remains on the retina for some time as the screen moves back and forth across the object. The overall effect on the eye is that the object viewed through the screen is seen more clearly when the screen is in motion.

Of course the object can be viewed best if the screen is taken entirely away. But, in the case of observing an object under a microscope, if we assume that the molecular pattern or lattice of the object itself acts as a screen, this screen remains always in place. Consider now a microslide viewed under a powerful microscope. The slide is located just a fraction beyond the principal focus of the objective lens of the microscope when the instrument is focused for maximum visibility. Assume at first that the slide is at rest. Only a relatively minute area or depth of the slide is clearly in focus. Light passing through the slide from below comes from many directions through the object and gives it its pattern as seen by the eye. The object is visible because of the reflection and refraction of light as it passes through the object. The reflected light comes from the molecules

and atoms of which the object is made up. If the slide is now set in motion at a certain frequency perhaps additional and slightly different rays of light would illuminate previously hidden parts of the object and make it more visible because of the motion? Perhaps other tiny nooks and crannies within the object would be illuminated by light from different angles and therefore make the perception of the object clearer?

The proper frequencies at which an object would have to be set vibrating to get this effect would have to be determined experimentally, and so would the amplitude of vibration. It is quite obvious that if the motion is too slow the object would appear blurred. But the blurring gets less as the frequency of vibration increases, and the blurring also diminishes as the amplitude of vibration decreases. A low frequency tuning fork struck vigorously presents a blurred appearance to the observer, but the motion of a high pitched fork given a slight blow cannot be detected by the eye. When the frequency at which an object is vibrated gets into the supersonic range as is the case, say, of a sugar solution set vibrating electrically by a quartz crystal, its motion cannot be detected by the eye.

Perhaps it is possible that certain rather high frequencies of rather small amplitude of vibration may not interfere with perception under a microscope, but rather help clarify the outline of the object. This has to be shown experimentally.

Several ways of applying supersonic vibrations for greater visibility have been considered. We have mentioned vibrating the object itself. An objection immediately arises. If the entire body is set in motion it might well be that the top or bottom lattice of molecules would not act as a moving screen, since all the molecules in the body would be moving simultaneously, and at the same rate. This would defeat the purpose of the experiment. We have considered applying vibration merely to the top or bottom surface only, which of course would be extremely difficult, if not impossible.

Another method would be to vibrate the source of light by which the object is illuminated. Light coming from slightly different angles, and passing through the object would possibly be refracted and reflected in somewhat different ways, and this might help. A third method would be to apply the motion horizontally to the optical system of the microscope itself, leaving the slide at rest. The searching eye of the microscope would thus cover a somewhat greater area laterally for one setting of the instrument and perhaps make the microslide clearer. Vibration might also be applied vertically to the

optical system of the microscope for greater penetration into the microslide and this with just the one manual setting of the instrument. Finally if the microslide were photographed, vibration might be applied to the photographic film, possibly securing a clearer picture.

The preceding considerations are offered for discussion and possibly for experimentation at some future date. Any clarification or suggestions on the topic will be welcomed by the writer.

THE THEORY OF SPONTANEOUS GENERATION

Francis X. Quinn, S.J.

Prefatory Note

Students of the history of science learn to digest one unpalatable wholesome truth, namely, that the mistakes they are called upon to chronicle and occasionally condemn are only equalled by their own mistakes.

In this treatment of the history of spontaneous generation we find that our present day views passed through numerous preparatory stages. We now enjoy the cumulative succession of researches which traversed every avenue of error, only occasionally illustrating the truth. Our modern day *enlightened* views are not the result of one observer. Rather they were built with endless slowness and much futile labor until they emerged, suddenly and unexpectedly, to enjoy their present existence.

The vagueness of the old masters (as we shall call them) is not due to unintelligence, but to the fact that they were working in an atmosphere which was less clarified than ours. We must dispossess ourselves of our modern bias before we undertake a journey in the company of these venerable guides of abiogenesis. This means we must steer a course between the right-hand extreme of attributing to them a knowledge and subtlety they did not possess and the left-hand extreme of denying they played any essential part in the development of science.

In criticising our predecessors we must not forget we stand on their shoulders and that we owe as much to their errors as we do to their wisdom.

THE THEORY OF SPONTANEOUS GENERATION ACCORDING TO THE ANCIENTS

I. Introduction

The opening scene for the history of spontaneous generation is the main harbor, the richest market of Ionia, Miletos. Colonized by the Cretans and named after a city on the northeastern coast of Crete, the new Miletos stood on a triangular limestone promontory between two gulfs not far from the Maiandros river. The city had four harbors in all and was accessible from Rhodes and farther south, from Phoenicia and Egypt and from the west and the Hellespont.[1] It was the trade in and out of these four harbors that was the spring of Miletos' wealth, greatness and science. Milesian sailors must have obtained considerable knowledge of the parts of the world to which their business extended. They became familiar with a variety of lands, languages, and legends. The stage was set, the actors ready—the theory of spontaneous generation made its debut.

The Cretan-Greeks were keen, imaginative and curious and asked themselves many questions. Nature presented a great number of phenomena in constant variation. The variations of life were noted at home and abroad. What was the source of life? Did living matter rise from non-living matter? Nature became their one great problem.

II. Thales

The earliest physiologist of whom we have record is Thales of Miletus (565 B.C.).[2] Our chief sources of Thales come from men who lived after him.[3] Whether Thales set down his views in writing is not known, and it was not known to antiquity. A passage in Galen purports to quote roughly a sentence from the second book of the work called, *On First Causes.*

> Water is the substrate, and all things are derived from it; the manner has already been described by me in Book One.[4]

His conclusion that water is the original substrate may seem rather fantastic and of no importance to us. The case is just the opposite. Without water life is impossible. As soon as water appears there may be life—an abundance of it. People living in most climates remain unconscious of the biological necessity of water, but along the Mediterranean shores, where everything dries up with the heat, and where desert or semi-desert conditions are common enough, the first merciful rains create something like a resurrection of nature.

Water is the key element in the early and later theories of spontaneous generation. For one who held that non-living matter generated into living matter, water would be a fine substrate. It is not unlikely that the theory of living creatures arising from the moist element originated with Thales.[5] His disciple, Anaximander, would explain creation by a spontaneous generation from the moist element. We also know that Thales thought of the earth as growing in water. Growth depends on moisture and all things are nourished by that of which they are composed.[6] Thus we have the fundamental element and the first trace of the theory of abiogenesis. We are told that Thales posited *life* in all inanimate objects on the strength of experiments with a magnet. The problem always was how to evoke this passive life. Thales, once a sailor from the Milesian harbor, began the quest to explain life and where it came from, not with his predecessors' myths but in concrete verifiable terms.

III. Anaximander

Anaximander (560 B.C.) a fellow and companion (*polites kai etairos*) of Thales, and in all probability his disciple, gave formation and publication to Thales' thesis on the origin of life.[7] He described the results of his scientific researches in a poem, *On Nature*. Briefly his thesis was that all living creatures arose from the moist element as it was evaporated by the sun.[8] The earth itself came into being through a kind of condensation of water. The original composition of the earth was mud. Living beings evolved through a kind of primordial procreation in this mud. The first creatures, as they arose from the moist element, were covered with "prickly wrappings."[9] These wrappings dried and in time dropped off.

Anaximander's theory of the origin of life is, in reality, most reminiscent of his fellow countrymen's legends of autochthonism—stories of how men were born of the earth they lived on.[10] With Anaximander we have the outline of the whole theory as it would develop up to the time of Aristotle.[11]

IV. Anaximenes

The job of carrying on the Melesian query into the origin of life next fell to Anaximenes (546 B.C.). To him, air seemed to be a key in the beginning of life. Men, animals and plants cannot live without breathing. Almost all the phenomena of nature could be explained by rarefactions or condensations of air. The whole universe moved with a respiratory rhythm.

Air is near to incorporeal, and since we come into being by an influx of air, it is bound to be both non-limited and rich so that it never fails.[12]

In Anaximenes we find the first mention of dialectic opposites producing new forms via spontaneous generation. It is unmistakable that the pneumatic contribution repeats itself many more times as our history unfolds.

V. Xenophantes

With Xenophantes, an exile from Colophon, western Greece assumes a place in scientific history. Xenophantes summed up his scientific researches in a poem similar to that of Anaximander. The theory of abiogenesis was set down: through the condensation of water and primordial mud life sprung into being. "For everything comes from earth and goes back to earth at last."[13] And again, "All things that come into being and grow are earth and water."[14]

Xenophantes also adds a third element, so important in the later medieval theory of abiogenesis: the sun. "The sun rushing on its way above the earth gives its warmth."[15]

Xenophantes based his theory on scientific results. His proof that the earth and sea were once mixed and slowly disengaged was based on the fact that he found fossil remains, prints of fish, seals and shells in the mountain rock.[16]

VI. Pindar

Here we insert the chief lyric poet of Greece. The odes of Pindar (476 B.C.) show us the perfect example of how scientific thought influences literary thought. In a description of the island of Rhodes, Pindar pictured it as growing up from the bed of the sea and blossoming forth from the salt waters.[17] Is this just a poetic image? The idea can certainly be found in Xenophontes. According to his theory the earth was a moist mixture gradually returning to the water state. Living creatures were a product of earth and water. Everything came from mud and would gradually return to mud. Thus Pindar's representation of the rising of the island of Rhodes would certainly tally with the Xenophontic theory.

VII. Anaxagoras and Archelaus

Before leaving this initial period of abiogenesis we might give mention to Anaxagoras (460 B.C.) and Archelaus of Athens (450 B.C.). Their theories of life and its origin are much the same.

In his treatise *On Nature,* Anaxagoras said that animals were created by the fall of seed from heaven to earth. The seeds of plants were likewise in the air and were washed down by the rain and took root in the ground.[18] Theophrastus will evoke this theory again when he assumes control of the Lyceum. Archelaus does not emphasize the seed theory but states that the earth is heated underneath and from the slime life does climb.

Thus is completed over a century of abiogenetic thought. We deliberately pass over many Eleatics who added nothing new to this first century of thought on abiogenesis. Parmenides and his followers seem to have accepted the Milesian theories.[19]

Footnote references in second installment.

To be continued.

WANTED: A SUCCESSOR TO FR. HENRI BOSMANS, S.J.

REV. THOMAS F. MULCRONE, S.J.*

"When are you Jesuits going to publish some consistent, integrated history of Jesuit contributions to mathematics, making use of the valuable studies of Fr. Bosmans?" Such in substance was the question recently put to the author by the well-known historian of mathematics and science D. J. Struik.

The following brief account of the life and scholarship of Fr. Henri Bosmans, S.J. (1852-1928) is presented in the hope that some American Jesuit mathematicians will investigate more thoroughly into the possibility of continuing the work begun by Fr. Bosmans.

Henri Bosmans was born in Mechlin (Malines), Belgium, April 7, 1852. He entered the Jesuit novitiate in 1871. Most of his religious life was spent at the Collège Saint-Michel in Brussels where he became professor of mathematics in 1887 and subsequently dean of studies, and where he corresponded or collaborated with almost all who have made significant contributions to the history of science during the period of about thirty years at the turn of the 20th century.

When we contemplate the multitude of his writings—over 500 articles, notes and reviews—and the scrupulous care he gave to understanding thoroughly the background of his subjects and checking sources, it seems incredible that a man engaged in teaching and

*Author teaches Physics and Mathematics, among other "catalogued duties" at Loyola University in New Orleans, La.

administrative duties and with very poor eyesight (for a time he was blind, and he was threatened all along with complete loss of sight) was able to accomplish so very much.

Fr. Bosmans' special interest was the history of mathematics in the 16th and 17th centuries, to which he devoted 91 of the 101 papers in Canon Adolph Rome's bibliography of Fr. Bosmans' principal monographs (1). Of the 91 papers 56 are concerned with the 17th century, the Jesuit missionaries in China accounting for 16 titles, other European Jesuits claiming 16 titles, while the final 24 papers deal with non-Jesuit mathematicians. The majority of the mathematicians considered by Fr. Bosmans were Belgians or Hollanders; many were connected with the University of Louvain.

Besides his published works Fr. Bosmans left considerable materials in manuscript form. These manuscripts, together with a copy of his printed papers, were entrusted after his death to the care of Fr. Leopold Willaert, S.J., historiographer of the Southern Belgian province (Belg. Mer.). They are kept in the archives of that province at the Collège Saint-Michel in Brussels.

Fr. Bosmans' papers and manuscript notes are of exceptional value because many of them are based on documents possessed only by the library of the University of Louvain, a library extremely rich in mathematical works of the Renaissance period, which was destroyed by fire in World War I. After Fr. Bosmans' death the books and articles he had procured over the years were sent to Eegenhoven. They too perished by fire when that library was destroyed in World War II (2).

Fr. Bosmans' work as a whole is of exceptional value also for another reason. His writings constitute valuable groundwork for further study of what George Sarton terms a "critical age," noting that, ". . . even historians of mathematics are not aware of the great part which Belgians took in the history of algebra and the prehistory of analysis . . ." (3). And that Fr. Bosmans' work was really the preparation for further historical syntheses is graphically put in Canon Rome's observation: "If one wishes to characterize in a word the work of Fr. Bosmans one will have to call him, I believe, an erudite rather than a historian. The work of assembling did not attract him at all. . . . Without trafficking in his admiration of magnificent historical structures he preferred to leave this to others, content, himself, to fashion a good brick rather than a beautiful house."

Several worthwhile publication and research projects dealing with the writings of Fr. Bosmans have been suggested.

G. Sarton's plea for the publication of a complete bibliography of Fr. Bosmans' papers has been rewardingly answered in the bibliography published by Fr. Henri Bernard-Maître, S.J. (5).

G. Sarton and Fr. Bernard-Maître agree (3) that all the papers dealing with Belgian mathematicians of the 16th and 17th centuries should be published together in book form, while the papers concerning Jesuit missionaries should be published in another volume. Sarton's reason for this is that Fr. Bosmans' papers should be available and studied, and some of them can now be had only in the very largest libraries (6).

Frs. Henri Josson, S.J. and Willaert have edited the correspondence of Fr. Ferdinand Verbiest, S.J., the famous astronomer, which Fr. Bosmans collected. (*Correspondence de Ferdinand Verbiest de La Compagnie de Jésus* (1623-1688), *directeur de l'observatoire de Pékin*, Commission Royale d'Histoire, Palais des Académies, Brussels 1938.) This edition, Fr. Willaert admits, is by no means definitive in its attempts to note and appraise the accompanying factors of Chinese influence.

Fr. Bernard-Maître, who spent about twenty years in China and is eminently prepared for such studies, has done considerable work preparing for publication the letters of Fr. Antoine Thomas, S.J., the successor of Fr. Verbiest in China. Lack of the necessary funds is the only thing holding up this publication. The work would require three volumes.

Canon Rome wrote that Fr. Paul Peeters, S.J. (7) proposed "that a critical bibliography be drawn up wherein should be indicated, for each of the entries, in what state he (Fr. Bosmans) found the subject, how far he brought it, and what has been done on it since then. That would be unfortunately," continues Canon Rome, "an enormous task, and one moreover which only a specialist in Renaissance mathematics would be able to undertake."

But besides these large publication projects there would seem to be opportunities for some small syntheses based on the fertile, but as yet almost completely neglected, work of Fr. Bosmans. To return to the matter of the question posed by D. J. Struik at the outset of this plea for a successor to Fr. Bosmans, I submit a summary of the suggestions made to the author by Professor Struik in several generous and encouraging letters.

A consistent history of the mathematical contributions by the Jesuit Fathers of the 17th century would be a worthwhile study in a field where, after Fr. Bosmans' death, nobody has particularly cared

to penetrate further. To provide such a historical edifice requires considerable erudition, but Fr. Bosmans has provided practically all the groundwork.

Particularly attractive and easy would be the treatment of the Belgian Jesuit mathematicians who labored in Europe, including especially François d'Aguilon, Jean-Charles de la Faille, Gilles-François de Gottignies, Théodore Moretus, Grégoire de Saint-Vincent, Alphonse-Antoine de Sarasa and André Tacquet (8). This would be a magnificent contribution to the prehistory of the calculus. Such a work could be conceived on two different levels: (a) The relatively easy one of studying the published papers of these authors, of Fr. Bosmans, and some collateral sources. This work might possibly be done in the United States, since it is likely that almost all of the materials are available, e.g. in Boston, New York, Providence, Ann Arbor. The only really necessary language requirements are Latin and French. (b) The more difficult one would be to study all the available materials, particularly the unpublished papers of these authors and of Fr. Bosmans. This would involve travel to Brussels and Louvain, and probably to Rome.

A similar consistent study of the Jesuit mathematicians in China would be a valuable contribution, especially to the cultural history of China. But, as Sarton notes, such a study "is of less interest to historians of mathematics" since it is concerned with "a secondary flow: the transmission of Western mathematics to China. Moreover these missionaries were not creative mathematicians." Fr. Willaert emphasized that to carry on Fr. Bosmans' work in this category would require not only an interest in mathematics but also some competence both as a historian and as a Chinese scholar.

Professor Struik noted also that the history of the Italian Jesuit mathematicians looks inviting and promising but that such a study may not possess the great measure of unity that characterizes the Belgian Jesuit mathematicians, and that it might well include such mathematicians as Cavalieri, Ceva and Grandi.

When I asked Fr. Willaert if any work was being done or contemplated based on the studies of Fr. Bosmans he wrote in reply: "Sorry to say, to my knowledge no one (in or out of the Society) is continuing the work of Fr. Bosmans. . . . Indeed it would be most desirable that a Jesuit should continue this work."

It is to be hoped that those who are directing the graduate study and research programs of *ours* will be reminded to acquaint those who have the talent for it with the work of Fr. Bosmans that they may

be inspired to make some welcome contributions in this particularly fitting field for Jesuit scholarship.

References and Notes

1. A. Rome, Le R. P. Henri Bosmans, S.J. (1852-1928). Notice biographique et index analytique de ses travaux historiques, Isis *12*, 88-112 (1929). I am indebted to this article for most of the biographical details mentioned.
2. The author is much indebted to Fr. Willaert for his very cooperative assistance, including most of the information noted concerning both the unpublished papers and the library of Fr. Bosmans, and recent work dealing with the Chinese Jesuit mathematicians.
3. George Sarton, An appeal for the republication in book form of Fr. Bosmans' studies on Belgian mathematicians of the sixteenth and seventeenth centuries, Isis *40*, 3-6 (1949). This article contains a summary of various additions and corrections made by Fr. Bernard-Maître, to whom Sarton sent his manuscript. This paper also has been of much assistance to the author.
4. H. Bernard-Maître, Un historien des mathématiques en Europe et en Chine: le Père Henri Bosmans, S.J. (1852-1928), Archives internationales d'histoire des sciences *36* (N.S.), 619-628 (1950). This makes extensive use of (1) and (7). See Archiv. Hist. Soc. Iesu *19*, 352 (1950).
5. ————. Biographie des oeuvres du Père Henri Bosmans, *Ibid.* 629-656. This bibliography lists 241 articles and notes, and 278 reviews.
6. Most of Fr. Bosmans' papers were published in the *Annales de la société scientifiques de Bruxelles;* a large number appeared in the *Revue des questions scientifiques;* and a fair number of them are in *Mathesis* and *Bibliotheca mathematica.*
7. R. P. Peeters, Le R. P. Henri Bosmans, S.J., Revue des questions scientifiques *13*, 201-214 (1928). The content of this paper may be had in a somewhat condensed form in Fr. Peeters' *Figures bollandiennes contemporaines,* Brussels 1948, a small volume containing the obituaries of five Bollandists who died after 1910 and that of Fr. Bosmans, "who, although not a Bollandist, nevertheless was an 'ami de la maison' whose spirit of scientific accuracy he brought to bear in his own field of specialization, the history of mathematics." E. Lamalle, S.J. in Archiv. Hist. Soc. Iesu *17*, 228 (1948).
8. See Archiv. Hist. Soc. Iesu *8*, 164 (1939); *15*, 214 (1946).

POWER OF DESTRUCTION, HOPE OF SURVIVAL*

Our modern age, with scientific research and discovery in the ascendant, faces grave and inevitable choices. On the one hand,

*This article, from the pen of Fr. Stephen X. Winters, S.J., is here reprinted from the Georgetown Development Fund booklet, entitled: *Science within a Moral Framework,* and appears with the permission of Rev. Charles J. Foley, S.J., Executive Director of the Fund. It is offered with the editor's suggestion that it synopsizes principles which all of *ours* are called upon so often to apply. *Editor.*

there is a temptation to a fatalistic pessimism, lest immeasurable power in the hands of man lead to blind self-destruction; on the other hand, an irrational optimism which would seek in the triumphs of science the solution of all man's perennial problems. But midway between them lies sound truth, which alone can safely avert the threat, temper overweening hopes, and sanely insure man's survival and prosperity in an era admittedly perilous.

Yet we face no fundamentally new problem. It has ever been the function of a university, professedly dedicated to the search of truth, to expose a sound philosophy of life, deep-rooted in the realization that man is not his own unfettered master, that his knowledge and the material on which he exercises his ingenuity are not ends in themselves, but means to a higher purpose. Guided by this principle, we have nothing to fear from the most penetrating researches, the most startling revelations of scientific inquiry. We have to fear only ourselves—to beware of the lapses of men in their responsibility to the Creator, to their country and to their fellowmen. For the scientist is no more than a man, albeit an especially gifted one. His special aptitudes no more emancipate him from divine and natural ordinances governing mortals than do those of the diplomat, the politician, the social worker, the educator. Knowledge is power—it is also responsibility.

Scientific education must then go hand in hand with the inculcation of solid basic principles of morality, and a reasoned philosophy of the universe, and of man's place therein. Without such rapport, science remains culturally sterile, fettered to the material, culminating in the mechanistic; with it, science becomes no mere handmaiden to commerce, industry or the professions, nor the unwitting tool of greed or despotism; but it emerges as a truly liberal pursuit, enlarging man's vision to a nobler understanding and richer experience of this world.

This ideal and this practice of uniting in the individual the disciplines of science and the tenets of Christian philosophy are symbolized for faculty and students of Georgetown in the official University seal: by the Cross of Christendom, and the terrestrial globe in the talons of the American eagle, and by the motto emblazoned above: *Utraque Unum.* The search for truth, whether in the secrets of nature or in the mysteries of revelation is one. "In His hands are both we, and our words, and all wisdom, and the knowledge and skill of works." (Wisdom, 7-6).

SCIENCE IN THE PROVINCE NEWS*

Rev. Stanley J. Bezuszka, S.J., Chairman of the Department of Mathematics at Boston College, has been elected President of the Northeastern Section of the Mathematics Association of America at the annual meeting of the section, held on November 4, 1956 at the University of Connecticut.

Your correspondent, Rev. Bernard A. Fiekers, S.J. has been appointed Member of the Committee on Chemical Education for the Council of the Am. Chem. Soc. for a three year term. The last two years of this will depend on his re-election to the Council.

Student body at Holy Cross now produces three scientific publications: *The Biology Journal,* under Father Anthony J. MacCormack's guidance, which first came off the press on December 13, 1956; *The Nucleus* (Journal of the College Physics Society) under the aegis of Father Robert B. MacDonnell, the second issue of which appeared this year; and the *Hormone,* under your editor's moderation, a chemical offering, now in its thirtieth year.

The Ceva Academy, the mathematics seminar at Boston College High School, which aims at preparing outstanding seniors for competitive examinations, has been organized under the guidance of Fr. J. Whitney Sullivan.

Lower division science club at St. Louis University High School is known as the *Macelwane Club.*

The Weston College (Seismological) Observatory of Boston College, under the guidance of Fr. Daniel Linehan and his capable assistants, is ever well documented in the *New England Province News.* Our weekly, *America,* and the *Boston College Alumnus* have contributed significantly to Father's national publicity on the occasion of his polar expeditions.

Fr. William R. Crawford, who taught physics at Holy Cross and Boston College before administrative calls were heeded, is to be congratulated on his golden jubilee as a Jesuit, celebrated in September, 1956.

Chemical Principles, A High School Text, by Fr. George R. Follen, spiral bound quarto, is in an experimental edition at present, being used at St. Louis University High School, at Loyola Academy in Chicago, and at Father's own school, St. Xavier's High School in Cincinnati, O.

*Courtesy of all *Province News* editors throughout the American Assistency, the bulk of public information given herewith has been culled.

Some Shortcuts in Roman Arithmetic, discovered in Vatican Archive material by Prof. Chauncey Finch of the Department of Classics, St. Louis University, brought nationwide AP publicity to Professor Finch and to Fr. J. Daly who is in the Mathematics Department at the University.

Our mathematicians, who have a flair for statistics, will enjoy the September 1956 issue of the *Memorabilia, S.J.* (vol. ix., fascic xxix), in which profiles of our age groups for each of our provinces throughout the world are to be found.

Fr. McCarthy of the Vatican Observatory, is staying at Alma College, while doing research at nearby Lick Observatory.

A third printing of *I Was Chaplain on the Franklin,* by Fr. Joseph T. O'Callahan, formerly active in this ASSOCIATION, came off the press on Dec. 10, 1956. During mid-January, 1957, this book is appearing in serial form in the *Boston Daily Globe.*

Fr. H. R. Jolley has been appointed Chairman of the Chemistry Department at Loyola University, New Orleans. He has produced a color film of the Loyola Campus, now showing. His picture appears in *Chemical & Engineering News* (p. 5423, 1956). His nationwide letter to the local sections of the Am. Chem. Soc., soliciting co-operation on manpower recruitment, has stimulated much local discussion of the scientific manpower shortage.

A graduate Department of Biology has been established on the Loyola (N.O.) campus, the only graduate department in the Liberal Arts Division.

The eleventh annual Eastern Colleges Science Conference will be held on the Georgetown campus, Thursday through Saturday, March 14-16, 1957. Undergraduate research topics should be sent to ECSC, Georgetown Univ., Box 39, Washington 7, D. C. (See back cover).

Georgetown Chemist Alumni conducted a luncheon event at the Atlantic City Meeting of the Am. Chem. Soc. in September 1956.

In June 1956 Boston College conferred honors on Peter J. W. DeBye, a towering chemical figure of our day and age.

Fr. Stephen A. Garber succeeds the late Fr. Joseph J. Molloy as Chairman of the Chemistry Department at St. Joseph's College in Philadelphia. He reports a part-time M.S. Chemistry program with record enrollment. It is a two-year program entailing two evenings per week and laboratory work on Saturday. Research is required. Radiochemistry is given in the first semester and this course will be expanded.

With the fellowship flier from the Chemistry Department, St. Louis University, comes not only a list of faculty and research interests, and of graduate personnel, but also a list of departmental publications from 1940 to date. The latter includes publication items from the Institute for the Teaching of Chemistry. NSF's Announcement for 1957 *Institutes for Science and Mathematics Teachers* lists St. Louis University for an Institute in Chemistry, for High School Teachers only, from June 17 to July 29, 1957, under the directorship of T. A. Ashford of the Chemistry Department. (See back cover). Possibly St. Louis is the only Jesuit listing among a few Catholic ones in a large overall list.

The Very Reverend Laurence J. McGinley, S.J., President of Fordham University, preached on *Religion and the Scientist*, at the *Science Mass* in St. Patrick's Cathedral, New York, on Sunday, Dec. 30, 1956, on the occasion of the 123rd meeting of the AAAS. This Mass was sponsored by the Albertus Magnus Guild. Fr. McGinley spoke on: Science and the Christian Tradition, The Problem of Coexistence, The Problem of Integration and finally The Vocation of the Religious Scientist.

Fordham Life for October 1956 carries from the pen of Fr. J. Franklin Ewing, S.J. a sketch of Dr. Daniel Ludwig and his work on the Japanese beetle and related species.

Fr. L. Keenoy, of Rockhurst College, secretaried two panel discussions on Freshman Chemistry, in the Midwest Association of Chemistry Teachers, held at Wheaton College (Ill.) Oct. 19-20 1956 and partook of a five-hour tour of the Argonne Laboratory on this occasion.

Fr. Joseph Teeply, of John Carroll University, has published three articles in *Church Property Administration:* Experiments in Acoustics, Acoustics in Schools, and Fundamentals of Pulpit Acoustics. There is a Father in the Netherlands who does similar work.

Mitteilungen, no. 116, counterpart of our own *Woodstock Letters* in the German Assistancy, carries obituaries of Fr. Franz Rensing, p. 564, medical doctor and secular priest before he became a Jesuit; of Fr. Heinrich Sierp, p. 596, who at one time studied chemistry under the well-known Professor Sørensen at Kopenhagen and was active in the profession in India before the outbreak of World War I; and of Fr. Joseph Assmuth, pp. 588-93, of Fordham fame.

The Towers on the Heights, 16 mm. 30 min. color film of the Boston College Campus, features some of our members: Frs. James J. Devlin, John J. McCarthy, Albert F. McGuinn and especially James

W. Ring who applies scientific principles in punting a football from Alumni Field in Boston to Fitton Field in Worcester (?). Fr. Devlin appears in a spectrography sequence; Fr. McGuinn, seeing a likely starch-iodine titration through its end-point; and Fr. McCarthy as dormitory prefect.

Recent medical and dental school grants include Creighton University's and Loyola's Stritch, a half a million dollars each from the Ford Foundation towards faculty salaries over ten years and for augmenting endowments. Microbiologist, Dr. R. Walter Schlesinger, of the St. Louis Univ. Medical School, received approx. $30,000 and a $14,641 renewal from NIH of the USPHS. Further, Loyola, Chicago, announces four grants totalling $24,267 from the Chicago Heart Association to the School of Medicine; $67,660, to the School of Nursing by the N. S. Department of Health, Education and Welfare; and an estate of $7500 for dental research, left by the late Mrs. C. O. Barnes, former patient of Dr. Edgar Coolidge, Professor of Dentistry, Emeritus. Marquette University is constructing a wing to its Dental School at a cost exceeding $700,000 to house modern research and clinical facilities, completing the quadrangle of medical and dental school buildings.

The Department of Philosophy at Boston College announces a summer philosophy institute for Jesuits only on *Contemporary Philosophies and Modern Thomism,* June 24-July 20, 1957. The earlier half, from June 24-July 6, 1957, will deal with *Modern Science and the Philosophy of Nature* by Fr. George P. Klubertanz, Assoc. Prof. Phil. of St. Louis Univ; the second half, July 9-20, 1957, is on *Mathematical Logic and Existentialism,* by Fr. Bernard J. M. Lonergan, Prof. Dogm. Theol., Gregorian Univ., Rome. Register and reserve for board and room with: Rev. Frederick J. Adelmann, S.J., Boston College, Chestnut Hill 67, Mass. (See back cover).

Dr. Leopold R. Cerecedo, Chemist at Fordham University, has been selected to receive the award *citizen of the year* by the *Instituto del Puerto Rico.* The Institute grants the award each year to that Porto Rican on the mainland who has done most for his native land.

The Georgetown Medical Center has received a grant of $75,000 from USPHS to aid animal research. Under the terms of the grant, Georgetown will supply an equal amount in matching funds.

At the University of Scranton, a grant of $1500 was received from the Anthracite Health & Welfare Fund to continue research on the *Silicosis Project* undertaken by the Chemistry Department two years ago.

The researches of Fr. Joseph A. Duke, of Wheeling College, on the *Chemistry of Muscular Contraction* was featured in an article in the Wheeling papers on Oct. 21, 1956.

Fr. Joseph F. Mulligan addressed the juniors of St. Andrew's-on-Hudson, circa Oct. 21, 1956, on the work of Jesuit Scientists.

On Georgetown's campus, the National Geographic Society erected a $3000 building for housing equipment for spectrographic studies of the planet Mars. Fr. Francis J. Heyden, Observatory Director, lectured on Mars over NBC network on the *Monitor* program.

Fr. Peters, of Xavier (Ohio) University, announced a grant of $2000 from the Raskob Foundation for Catholic Activities Inc. for continued research in electroencephalography and brain waves. This work has been in progress for six years.

Charles White, Univ. Detroit '52, has invented a bearing which operates without lubrication by using *Teflon*, a DuPont product, twice as heavy as *Nylon*. The new bearing will be used in the man-made satellite, to be launched in 1957, in connection with the International Physical Year. Its use in automobiles is expected by 1959.

Fr. Ernest Gherzi, of the Province of Paris, former Director of the Zikawei Observatory in Shanghai, is spending six months at Loyola, New Orleans. He is associated with the St. Louis University Institute of Technology and is doing meteorological investigations for the USAF.

Cross & Crucible, Chemists' Club of the College of the Holy Cross, is putting on an open house for the high school science students of Worcester County on Feb. 25, 1957. Dr. D. S. Herr, of the Shell Chemical Co., will address the group. The event will feature exhibits from the Atomic Energy Museum. Details of the latter can be got from Fr. J. A. Martus at the College.

Practica Quaedam

Chemical and other subscript notation is easily achieved on the typewriter. One depresses the capital key for lower case numerals and letters to only the slightest extent. Too deep a depression may not take on platens of small diameter and are to be avoided where many carbon copies are required, as well as in making master copies for duplication. A little practice might be rewarding. A key for plus and equals, $+ =$, comes standard with many machines today. So chemists are generally satisfied with the addition of some device for an arrow. The following characters are helpful in producing organic chemical formulas — = /.

In drawing tetrahedra for work in structural chemistry, the use of dotted lines for hidden edges can be avoided by showing a projection of the triangular base upwards, and the apex downwards.

Hot test tubes are apt to melt the rubber covering of the jaws of clamps. Protection from a folded piece of filter paper obviates the cleaning difficulty otherwise bound to arise after the experiment.

Logarithmic slide rule divisions are helpful in setting up logarithmic or semi-such graphs: the usual slide rule, for paper work; the demonstration rule, for chalk board work.

The collection of spilled mercury presents a problem. Pity some poor exhibitor at a science fair, trying to collect the elusive droplets! A silver coin is amalgamated at the surface by rubbing it with some of the mercury. Then this coin is used to attract the droplets to itself so that the mercury can be collected into one blob. See J. Chem. Educ., *22*, 463 (1945) where Fr. A. F. McGuinn of Boston College calls attention to this technique.

A simple ozonizer consists of a U-tube which is loosely packed with coarse steel wool. A high frequency spark from a coil is played on the glass. The exit for the ozone mixture consists of Tygon tubing, since rubber is attacked by ozone. The usual starch potassium iodide tests might suffice. Fr. James E. Ransford, now at Los Gatos, suggests this device in J. Chem. Educ., *28*, 477 (1951); Welch Physics and Chem. Digest, *2* (2), 8 (1952).

The high frequency generator, which we use for the production of ozone, switch serves for a number of uses: leak detection in vacuum systems; the activation of demonstration neon tubes; as a deionizing source in a Cottrell smoke precipitator model; and it is said to be handy in setting off a demonstration dust explosion. Any other uses? Item no. 63-765, Cambosco sells its model of generator for $12.50.

Polyethylene squeeze bottles are on sale in variety stores, designed for dispensing mustard and ketchup. An enterprising student has adapted one of these for use as a wash bottle.

Sun lamps make a good source of ultraviolet radiation for certain organic halogenation reactions. A burned out sun lamp bulb can be salvaged for use as a flask in this connection. It matches the lamp in size; transmits such radiation; and its shallow bottom enhances exposure of an area larger than that usually provided by quartzware.

In trace analysis, the replacement of glassware by polyethylene ware is a real convenience. Ions dissolved from glassware can alter the concentrations of extremely dilute solutions to a disastrous de-

gree. Plasticware obviates the difficulty. This should be of interest in certain biological work, in spectrography and generally in chemistry.

Upon a time, we got carbon dioxide free caustic solutions from concentrated caustic solution, 50% for example. The modern technique is to run dilute NaCl or KCl solutions through an anion exchange column under carbonate-free conditions.

The permanent attachment of indicating dial thermometers to laboratory ovens and furnaces makes for easy reading of temperatures as well as it obviates having to replace damaged thermometers which somehow seem to accumulate on such apparatus!

Flakes of stop cock grease that find their way into the tip of a burette are a nuisance. Some advise holding a lighted match close to the tip so as to melt the grease and to flow it off: surely a hazard for the glass tip. Another expedient is to select a piece of fine copper wire and dip it into dilute nitric acid so as to take down its diameter, so that it can be pushed through the aperture of the burette tip for the mechanical dislodging of the particle.

There are approximately 28 g. to the ounce, and 28 L. to the cubic foot. Accordingly, the ounce molecular cubic foot volume of a gas corresponds approximately to the familiar gram molecular volume: 22.4; and the value of R on this system, in cubic foot, atmospheres, per degree Kelvin, per ounce mol likewise approximates the usual corresponding value 0.082. This should be of help in calculations.

In exercises and examinations on the balancing of chemical equations, one professor requires his students' adding up the number of molecules throughout the equation and noting this number in the margin of the page. This aids rapid correction of the work. Does it simplify proctoring?

As the bulk of scientific periodicals increases, the stacking of serials vertically in sections becomes more impracticable. When space for new additions has to be found annually, or even quinquennially, the two hundred or so volumes of the next set have to be pushed forward and the work is repeated set for set right through the library. It has been proposed that the larger sets be stored horizontally at a given shelf level, going from one section to the next, until the volumes run out. Then shorter sets, which are more easily moved, follow at the same level. In a chemical library for example, *Chemical Abstracts*, a bulky set which is probably the most often consulted work, would occupy a horizontal line of shelves from section to sec-

tion at about eye height. It might be followed by a smaller set such as *Chemical Reviews*. The next most frequently consulted longer set, such as the *Journal of the American Chemical Society*, or the London journal might be above or below it, and so forth.

Selenium rectifiers are limited to certain amperage ratings so that they will not get overheated and burn out. By immersing them in an oil bath, such as Nujol, they can be operated at up to ten times their rated amperage (Popular Electronics, 5 (3), 67 (1956)).

Windshield wipers have been used in laboratory for special stirring applications. One is the vertical agitation of a solution in a test tube in freezing point determinations. Some operate on both air and vacuum.

Ohaus Scale Corp. of Union, N. J. markets "Clear View" plastic case metric weights, 10 mg. to 50 g., model 1241, at $3.25, with the suggestion that they are reasonably priced for selling to students "for keeps."

The Graham's Law of Effusion apparatus is pressed into double duty in a recent laboratory manual of physical chemistry. The aperture through which the gases diffuse can be replaced with a capillary tube. Thus both molecular weight and molecular diameter can be determined by this *relative method*. H. D. Crockford & J. W. Nowell, Laboratory Manual of Physical Chemistry, Wiley, N. Y., 1956, p. 46.

The laboratory production of $NaHCO_3$ and Na_2CO_3 by the Solvay process using dry ice, salt and ammonia has the disadvantage of filling the air with ammonia fumes. Watt & Hatch suggest in their laboratory manual the use of $(NH_4)_2CO_3$ and they cut down the CO_2 requirement appropriately.

The *Field-Emission Electron Microscope* claims to reveal the architecture of crystals and resolve individual atoms and molecules (E. W. Müller, A New Microscope, Sci. American, May 1952). It is manufactured by the National Instrument Laboratories, Inc., 6108 Rhode Island Ave., Riverdale, Md. One of their assembled models sells as low as $325.

MANUSCRIPTS NOTICE

Manuscripts for publication in the BULLETIN are sorely needed and urgently requested. News items from your science department are very desirable. Why not plan on sending your contribution by the end of the Easter vacation? April 21, 1957.

Film Reviews

The Analytic Balance. 16 mm., b & w, sound, 15 min. Univ. of Minnesota. This film lays a fine foundation in the technique of using the analytic balance. It should relieve the instructor of teaching such details as the method of swings and the systematic selection of weights to be added or withdrawn in the approach to the correct weight. Tedious precautions on tweezer instruction, the open window and the arrested beam while adding weights are also obviated. The inclusion of the use of tares, and the graphical approach to the determination of rest point, which precedes the numerical approach, are good features. It is to be regretted, however, that the method of sensibilities, or sensitivities if you prefer, for matching rest and zero points is not included. Further, many students disagree with the scale readings called during the show. bafSJ

The Chemistry of Fire (Damage Control). 16 mm., b & w, sound, ca 18 min. for reel A, U. S. Navy. The first part of this film emphasizes theoretically the conditions necessary for undesirable combustion, and is, accordingly eminently adapted for teaching combustion in beginners' chemistry. Vaporization by heat, ignition point, flash point and combustion are admirably demonstrated and taught. The transmission of heat, the spread of fire and its suffocation are treated. The instructor might then treat of spontaneous combustion, dust explosions and the like, since they do not come up in this film. The second reel of this film is not reviewed here. bafSJ

The Slide Rule. C and D Scales. 16 mm., b & w, sound, 24 min. U.S.O.E. Multiplication, division and the combination of these operations is shown in this film. Examples are largely simple; the narrative is extremely repetitious; and the student is instructed to set decimal points mentally. bafSJ

The Ultimate Structure. 16 mm., b & w, sound, ca 25 min. The North American Philips Co., Inc., (Norelco) 100 E. 42nd St., New York 17, N. Y. (Borrowed from Atlantex Corp., 909 Boylston St., Boston 15, Mass.) This film deals largely with x-ray diffraction and related x-ray spectrography. Besides featuring preparative tech-

nique and use of the Norelco instruments, it includes the general underlying principles, camera and automatic recording, molecular and crystalline models of many substances and typical applications in various industries. Especially clear are the reflection demonstrations of interference patterns with water waves and the ease of transfer of this argument to light and x-rays. Spectrography is introduced on the foundation of diffraction by comparison and contrast, based in part on a simple mathematical equation. Historical flavor is gained through portraits of discoverers, such as that of Bragg. *bafSJ*

Parliamentary Procedure. 16 mm., b & w, 11 min., Coronet. If you view this film in hopes of learning the finesse of the filibuster, you may be disappointed. It is but a simple introduction to the practical essentials of parliamentary procedure: order of business, reports, action on reports of the secretary and the treasurer (audit sufficing for the latter), motions, their seconding and discussion, amendments and motions to adjourn. The order of action on a motion with two amendments, maximum, is stressed and reviewed. Secondary amendments not related to primary ones are ruled out of order. A village meeting constitutes the pattern of this film; but appropriate commentary accents the flow of business. Simple illustrations of general interest are used. All can understand. Every club should show this film at least once a year. Appropriate by-laws to this effect would be of help. *bafSJ*

Parliamentary Procedure in Action. 16 mm., b & w, 16 min., Audio Visual Center, Indiana University. In contrast to the title, *Parliamentary Procedure,* a meeting of a school dramatics club is here presented, though without commentary, as an example of a meeting which is ideally conducted. Incidents are included which illustrate the principles expounded in *Parliamentary Procedure;* even a *division of the house* is called. Thus the film complements *Parliamentary Procedure. bafSJ*

How to Study. 16 mm., b & w, sound, 10 min., Coronet. Motivation is induced by the portrayal of external techniques, such as the efficient division of study time, concentration, introduction to a task by rapid reading, self-examination on topical matter, along with the cumulative technique which passes beyond the library stage to writing to a government agency. It is doubtful if this film is suitable for Freshman collegians. *bafSJ*

Book Reviews

Kramer, Friedr., Einschlussverbindungen, Springer, Berlin, Göttingen, Heidelberg, 1954, 115 pp. This monograph on the topic of *Inclusion Compounds* is seldom if ever cited in the American literature, though the topic itself is of great interest, especially to the petroleum industry. Under the heading of inclusion compounds are gathered such topics as the clatherates, molecular complexes, gas hydrates, urea hydrocarbon complexes, the starch iodine reaction and sundry other exceptional phenomena that the general chemist has at one time or another to consider.

Consider the addition of urea to a mixture of aliphatic hydrocarbons; how it wraps itself through hydrogen bonding around the longer chain species to precipitate them from the mixture for the recovery of both reagent and product, and you have some idea of the practical value of the treatise; some idea of a relatively new structural tool, for the up-grading of octane rating, to select but one example.

This work includes many practical procedures, copious diagrams and structure proofs, as well as a reference bibliography of 126 items. It seems to provide answers to many phenomena hitherto puzzling to the non-specialist in the field. It should be of exceptional interest to the colloid chemist and should provide necessary background for almost every chemist actively engaged in research at the bench. *bafSJ*

Fromherz, Hans, *Physikalisch-chemisches Rechnen in Wissenschaft u. Technik,* Verlag Chemie, G.m.b.H., Weinheim, Bergstrasse, 1956, 316 pp. The author is probably best known in this country for his book: *Englische u. deutsche chemische Fachausdrücke,* published with Sir Alexander King. The work under discussion here is a problem book in physical chemistry. It is tailored both for academic exercises in the treatise as well as for reference in handling such problems as are apt to come up in professional activity. Apparatus is provided for this distinction; the sequence is so planned that no given problem requires a mastery of material later to be treated in

this work; further, the contents are arranged in an order more or less familiar to users of domestic texts. This work reflects the profound academic and industrial career of its author. It is ever practical, nor does it lack depth where investigation calls for it.

Each topic is introduced with a succinct derivation of formulas. their symbols are generally acceptable here and have been made self-consistent throughout the work. The notes or *Bemerkungen*, appended to many of the problems, are charged with instructional value far in excess of their length. Most noticeable is the rationalization of safety practice in laboratory work. Indeed, the entire point of some problems, notably the use of the Carius tube within safety specifications, seems to be aimed at safety and efficiency in laboratory practice. Other points of experienced judgment include briefers in mathematical technique where called for, the discussion of errors of measure in the selection of methods, pointers on the units of physical measure, and, above all, a mastery of chemical equilibrium in practice that is seldom achieved.

Regrettably the use of this work in this country is limited to background and reference reading under current academic practice

bafSJ

LIBERAL ARTS AND ENGINEERING PROGRAMS COMBINED

The so-called *three-two* program combines three years of liberal arts training with two years of engineering training. At the end of five years, the student holds two degrees: one in his liberal arts major, and one in engineering. Under this plan liberal arts colleges are affiliated with one or more engineering schools. The larger institutes of technology are affiliated with as high as 28 liberal arts colleges. At present there are 28 engineering schools with which 145 liberal arts colleges are affiliated.

St. Louis and Notre Dame Universities are listed among the Catholic institutions to which the liberal arts colleges are affiliated in this program. Fourteen Catholic colleges are affiliated through the *three-two* program. The Jesuit colleges, Regis and Rockhurst, are affiliated with St. Louis University. Contributor is indebted to Rev. M. L. Fay, S.J., for a preliminary survey of this progrem. *bafSJ*

CITATIONS FROM FR. KIRCHER

REV. JOHN P. DELANEY, S.J.

In the new publication, *The Sun at Work*, Newsletter of the Association for Applied Solar Energy, Fr. Athanasius Kircher is cited by Guy Benveniste, editor, in a survey entitled: *Burning Glasses: from Archimedes to Lavoisier.*

"Apparently, it was not until Kircher (1601-1680)," writes Benveniste, "that a second experimental proof of this achievement was performed. Kircher relates in *De Arte Magna Lucis et Umbrae* an experiment of his own where he obtained with five mirrors enough heat to burn wood. He assumed that in this way Proclus must have been able to set fire to Vitellius' fleet during the siege of Constantinople."

This citation calls to mind another, by Galileo, in his final and greatest work, *Two New Sciences*. "Speaking of the effects produced by the mirrors of Archimedes, it was his own books (which I had already read and studied with infinite astonishment) that rendered credible to me all the miracles described by various writers. And if any doubt had remained the book which Fr. Buonaventura Cavalieri has recently published on the subject of the burning glass and which I have read with admiration would have removed the last difficulty."

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Athanasius Kircher (De arte magna lucis et umbrae, Vol. 10, p. 874) relates experiment duplicating that of Archimedes.

Galileo Galilei, Two New Sciences, Dover, New York, p. 41.

BIBLIOGRAPHY OF JESUIT PUBLICATIONS IN CHEMISTRY

REV. BERNARD A. FIEKERS, S.J.

With the closing of the year 1956 *Chemical Abstracts* has seen fifty years of publication. This publication is now known as the *Key to the World's Chemical Literature.* It seems then that such a publication might be the best norm one can find at present for the purpose set before us, viz. producing a basic list of contributions to chemistry made by Jesuits.

Not that Jesuits did not publish chemical material prior to 1906 or 1907! Many worthy items may have been published since that date

but *Abstracts* has not carried them. Again, certain trivial items have been abstracted, notably one or more of the author's own contributions. But, by and large, where is there a better practical norm for such difficult judgments, often attempted and as often criticized? At least we can here establish some basic list of *our* contributions, which may be prefected later by way of supplement. Note also that some contributions here listed were made before certain authors entered the Society; that many contributions listed in *Abstracts* were made by physicists, or scientists of other persuasion, as we know them, and that certain items of recent date are included, most certainly to be abstracted; but as yet they have not appeared.

If this is to be a truly basic list, then the co-operation of many has here to be requested. Our first need is an expanded list of non-American Jesuits who published in chemistry; our second, the contribution to this BULLETIN of references to new publications by ours as well as new and forgotten names. Supplementary contributions will be greatly appreciated.

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(To be continued)